CBEAM Beam Element Connection

Defines a beam element.

Format:

1	2	3	4	5	6	7	8	9	10
CBEAM	EID	PID	GA	GB	X1	X2	X3	OFFT/BIT	
	PA	PB	W1A	W2A	W3A	W1B	W2B	W3B	
	SA	SB							

Example:

CBEAM	2	39	7	13	8.2	6.1	-5.6	GOG	
		513		3.0					
	8	5							

Alternate Format and Example:

CBEAM	EID	PID	GA	GB	G0			OFFT/BIT	
	PA	PB	W1A	W2A	W3A	W1B	W2B	W3B	
	SA	SB							

CBEAM	2	39	7	13	105			GOG	
		513							

Field	Contents
EID	Unique element identification number. (0 < Integer < 100,000,000)
PID	Property identification number of PBEAM, PBCOMP, PBEAML or PBMSECT entry. (Integer > 0; Default = EID)*
GA, GB	Grid point identification numbers of connection points. (Integer > 0; $GA \neq GB$)
X1, X2, X3	Components of orientation vector $\vec{v}$, from GA, in the displacement coordinate system at GA (Default), or in the basic coordinate system. See Remark 9. (Real)
G0	Alternate method to supply the orientation vector $\vec{v}$ using grid point G0. Direction of $\vec{v}$ is from GA to G0. $\vec{v}$ is then transferred to End A. (Integer > 0; $G0 \neq GA$ or GB)
OFFT	Offset vector interpretation flag. See Remark 9. (Character or blank)

Field	Contents
BIT	Built-in twist of the cross-sectional axes about the beam axis at end B relative to end A. For beam p-elements only. (Real; Default = 0.0)
PA, PB	Pin flags for beam ends A and B, respectively; used to remove connections between the grid point and selected degrees-of-freedom of the beam. The degrees-of-freedom are defined in the element's coordinate system and the pin flags are applied at the offset ends of the beam (see Figure 8-15). The beam must have stiffness associated with the PA and PB degrees-of-freedom to be released by the pin flags. For example, if PA = 4, the PBEAM entry must have a nonzero value for J, the torsional stiffness. (Up to five of the unique Integers 1 through 6 with no embedded blanks.) Pin flags are not allowed for beam p-elements. Pin flags combined with offsets are not allowed for SOL 600. Pin flags are not presently allowed in MD Nastran SOL 700.
W1A, W2A, W3A W1B, W2B, W3B	Components of offset vectors from the grid points to the end points of the axis of the shear center. See Remarks 7., 8. and 9. (Real; Default = 0.0)
SA, SB	Scalar or grid point identification numbers for the ends A and B, respectively. The degrees-of-freedom at these points are the warping variables $d\theta/dx$. SA and SB cannot be specified for beam p-elements. (Integers > 0 or blank)

*See the BEAMOR entry for default options for field 3 and fields 6 through 9.

Remarks:

1. Element identification numbers should be unique with respect to all other element identification numbers.
2. For an additional explanation of the beam element, see the Beam Element (CBEAM) (p. 58) in the *MD Nastran Reference Manual*. Figure 8-15 defines beam element geometry:

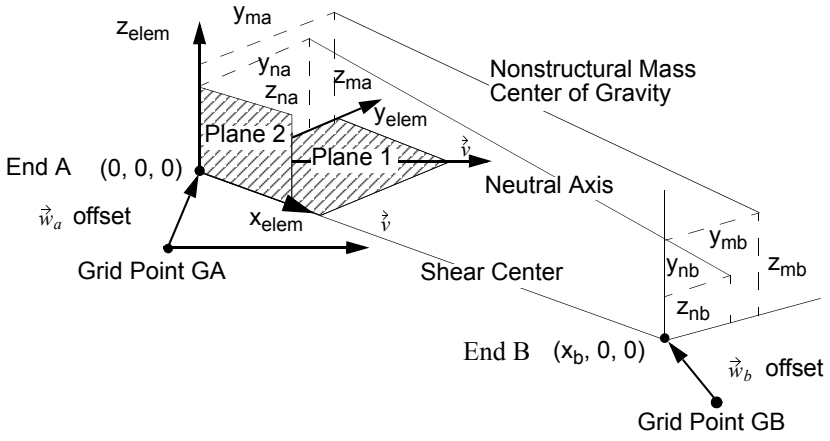

Figure 8-15 CBEAM Element Geometry System (Non p-adaptive)

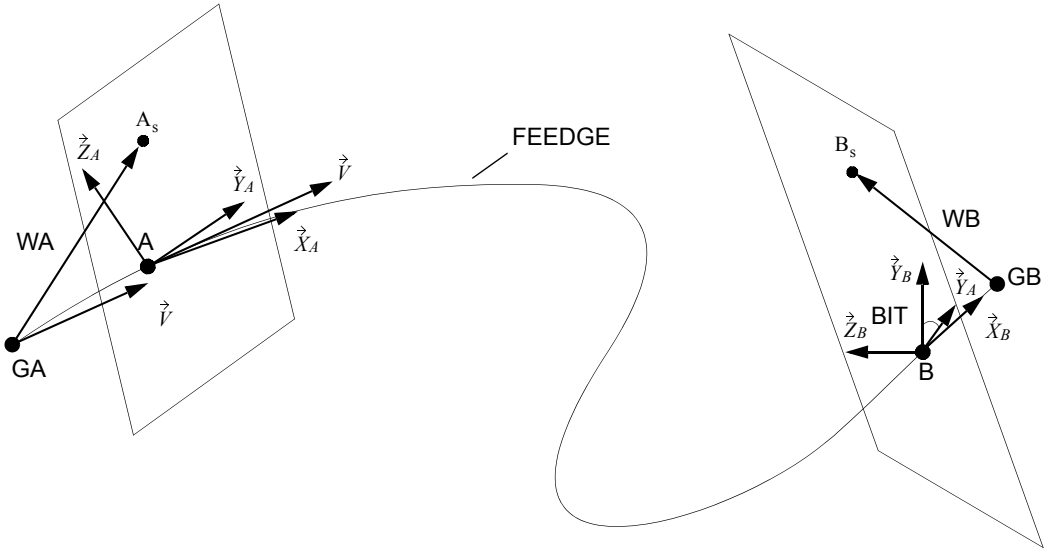

Figure 8-16 CBEAM Element Geometry System (p-adaptive)

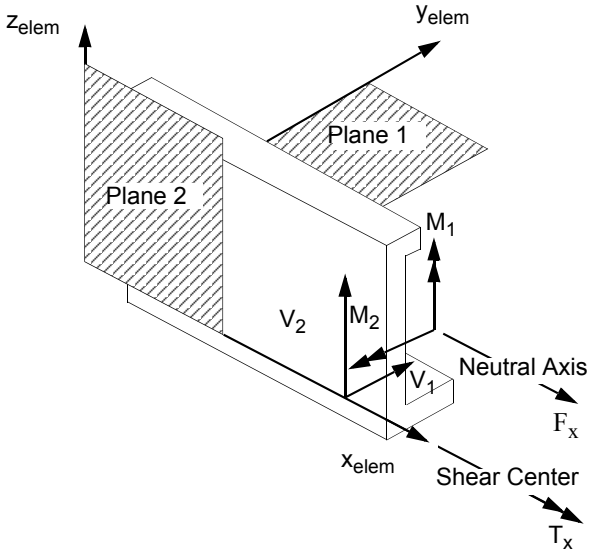

Figure 8-17 CBEAM Internal Element Forces and Moments

3. If field 6 is an integer, then G0 is used. If field 6 is blank or real, then X1, X2, X3 is used.
4. G0 cannot be located at GA or GB.
5. The rules for the continuations entries are:
   - Both continuations may be omitted if there are no pin flags, offsets, or warping variables.

- If the second continuation is used, then the first continuation must be included, even if all fields are blank.
- If the second continuation is omitted, torsional stiffness due to warping of the cross section will not be considered.

6. If warping is allowed (SA and SB > 0), then SA and SB must be defined with SPOINT or GRID entries. If GRID entries are used, the warping degree-of-freedom is attached to the first (T1) component.
7. Offset vectors are treated like rigid elements. Two methods are available for the computation of offsets: original and enhanced. The default method is the original method. The enhanced method is requested by the Bulk Data entry MDLPRM,OFFDEF,LROFF. For options of offsets, please refer to the Bulk Data entry MDLPRM,OFFDEF,option.
8. If the CBEAM element is referenced by a PSET or PVAL entry, then a p-version formulation is used and the element can have curved edges.
   - By default, the edge of the element is considered straight unless the element is a p-element and the edge is associated to curved geometry with a FEEDGE entry.
   - If a curved edge of a p-element is shared by an h-element without midside nodes, the geometry of the edge is ignored and considered to be straight. Edges with midside nodes cannot be shared by p-elements.
   - For the beam p-element, components of the offset vectors parallel to the beam axis (FEEDGE) will be ignored.
   - For the beam p-element, offset vectors can only be specified in the displacement coordinate systems at the grid points.
9. If the element is a p-version element, BIT in field 9 contains the value of the built-in-twist measured in radians. Otherwise, OFFT in field 9 is a character string code that describes how the offset and orientation vector components are to be interpreted. By default (string input is GGG or blank), the offset vectors are measured in the displacement coordinate systems at grid points A and B and the orientation vector is measured in the displacement coordinate system of grid point A. At user option, the offset vectors can be measured in an offset system relative to grid points A and B, and the orientation vector can be measured in the basic system as indicated in the following table:

String	Orientation Vector	End A Offset	End B Offset
GGG	Global	Global	Global
BGG	Basic	Global	Global
GGO	Global	Global	Offset
BGO	Basic	Global	Offset
GOG	Global	Offset	Global
BOG	Basic	Offset	Global

String	Orientation Vector	End A Offset	End B Offset
GOO	Global	Offset	Offset
BOO	Basic	Offset	Offset

Any attempt to specify invalid combinations results in a bulk data entry input error message. For example, a value of OOO (indicating offset and orientation vectors are specified in an offset reference system) results in a fatal error since the orientation vector cannot be specified in an offset system. The offset system x-axis is defined from GA to GB. The orientation vector $\hat{v}$ and the offset system x-axis are then used to define the z and y axes of the offset system. A vector is formed from a cross product of a vector going from Grid A to Grid B and the orientation vector to create the offset coordinate z-direction. To obtain a nonzero cross product the orientation vector must not be parallel to both vectors from Grid A to Grid B for the offset coordinate system and End A and End B for the element coordinate system. (Note: The character “O” in the table replaces the obsolete character “E”.)

10. For RC network solver in thermal analysis, the X1, X2, X3, OFFT, PA, PB, W1A, W2A, W3A,W1B, W2B, W3B, SA and SB are ignored.